Formation of Electro- and Photoelectret States in CdI_2 Crystals with PbI_2 Nanoinclusions

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Layered structure of lead and cadmium iodide crystals is specified by the coexistence of different types of chemical bonding in them: ionic-covalent within the structural layeres and interlayer van der Waals. At low temperatures these crystals can be used as ionizing-radiation detectors in the nanosecond range and at temperatures higher than 150 K they can form a medium for information recording. Study of the electret properties is of scientific interest as the method to investigate structural defects of the photoelectrets.

To obtain electroelectret state, an electric field was applied to the sample at room temperature (without irradiation). After 10-minute interval the temperature in the cryostat was reduced to 80 K. Short-circuited sample was heated at a constant rate of 0.06 deg/sec. Thermally stimulated depolarization current was registered as a function of temperature.

Photoelectret state in the crystals was produced after their exposure to light at the intrinsic absorption edge of CdI_2 (3.5 eB) at 80 K. Energy distribution functions of populated localized states were calculated on the base of thermally stimulated depolarization curves of electro- and photoelectret states.

Electroelectret state is generated mainly by the trapping levels with the depth 0.3-0.56 eV (distribution function peak is located at 0.44 eV). This is due to the dipole polarization of PbI_2 molecules that compose monolayers of nanoinclusions [1].

Photoelectret state of the crystals, in addition to the dipole polarization, typical for electroelectert state, contains the trapping centers stipulated by the point defects (at 0.05, 0.17 and 0.36 eV) and the deepest trapping centers near 0.56 eV. The latter are thermally ionized at the temperatures 300-320 K and possess specific spectral sensitivity area near 3.1 eV [2]. This allows us to attribute them to the linear defects of CdI_2 structure with PbI_2 nanocrystals localized in the vicinity.

1. Galchynsky O.V., Gloskovskaya N.V. and Yarytska L.I. Deep acceptor trapping centers in CdI_2-PbI_2 crystal system // Functional materials. – 2014.- V.**21**, №3. - P.243-246.

2. Gal'chinskii A.V., Gloskovskaya N.V. and Yaritskaya L.I. Carrier trapping and delocalization in PbI_2-containing CdI_2 crystals // Inorganic Materials.- 2012. - V.**48**, №4. - P.423-427.